

**DESIGN OF A PORTABLE SWINE PROCESSING MACHINE FOR THE
BRESCHINI & SONS FARM**

by

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2010

TITLE : Design of a Portable Swine Processing Machine

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DATE SUBMITTED : December 3, 2010

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ACKNOWLEDGEMENTS

First, I would like to thank God, for getting me passed challenges in my life and for the creation of my enemy, wild hogs.

Second, I would like to thank Dr. Richard A. Cavaletto for the assistance with the completion of my senior project. I feel as though I received the best possible help from him and I am very grateful that he was there through every step of the way.

Third, I would like to thank all of the employees at Bud's Custom Meats for allowing me to perform extensive research on their processing machine and for answering many questions I had in regards to the portable swine processing machine.

Fourth, I would like to thank my Father and best friend, Richard Breschini, for his support through college and for the permission for me to perform research on his property for the completion of the senior project.

ABSTRACT

This senior project discusses the design factors associated with the construction of a portable swine processing machine. The portable swine processing machine is composed of the following stations linked to the entire meat processing system: internal organ removal station, rinsing/cleaning station, skin threshing station, and the refrigeration station. This project goes into depth of the function of each station and how it contributes to the ending result, the consumption of the wild hog. The processing machine meets all sanitation requirements and can be operated safely and efficiently, satisfying the needs of the Breschini & Sons farm.

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TABLE OF CONTENTS

	PAGE
SIGNATURE PAGE	ii
ACKNOWLEDGEMENTS.....	iii
ABSTRACT.....	iv
DISCLAIMER STATEMENT	v
LIST OF FIGURES	vii
LIST OF TABLES.....	viii
INTRODUCTION	1
LITERATURE REVIEW	2
PROCEDURES AND METHODS.....	5
RESULTS	12
DISCUSSION	14
RECOMMENDATIONS	15
REFERENCES	16
APPENDICES	
Appendix A: How Project Meets Requirements for the ASM Major.....	17
Appendix B: Construction Drawings.....	20

LIST OF FIGURES

	PAGE
1. Wild Hogs Damaging Crops.....	1
2. Skeleton of Wild Boar	2
3. Wild Boar Piglet	3
4. Inside of Wild Hog Mouth.....	3
5. Bud's Custom Meats Sign	5
6. Bud's Custom Meats Portable Processing Machine	6
7. Inside Refrigeration Unit	6
8. Crane Located Above Refrigerator is Used for Skin Removal.....	6
9. Overview of Wild Hog Processing Machine	7
10. 90-Gallon Water Tank for Washing/Rinsing	8
11. WARN Winch for Pulling Force	9
12. Skin Threshing Design.....	10
13. Portable Refrigeration Unit.....	10
14. Design Layout of Portable Processing Machine	12

LIST OF TABLES

	PAGE
1. Cost Analysis of Portable Swine Processing Machine	13

INTRODUCTION

The Breschini & Sons farm is a 1000 acre farm located in the Salinas Valley. The Breschini & Sons farm is currently suffering from wild hogs consuming and destroying acres of romaine lettuce along with a possible introduction of *Escherichia Coli* to the fields. With the new E. Coli standards, these pests must be eradicated from the farm in order to promote sanitary health conditions. Currently, the employees at the farm are only able to eliminate about 3 wild hogs per week, mainly due to time consumption of processing wild hogs by hand for food consumption, and actual farming issues that need to be attended to rather than rodent troubles.



Figure 1. Wild hog damaging crops.

The Breschini & Sons farm needs to take a different approach to this situation and invest in an advancement to the farm, which will present a solution to the invasion of the wild hogs and their potential contamination of the romaine lettuce crops. A need exists to design and construct a portable swine processing machine capable of eliminating wild hogs at an efficient rate of about 10-15 wild hogs per hunting expedition in one given day. By accomplishing this task, the threat of wild hogs can be eliminated, which will result in the increased efficiency of the overall farm production of produce.

The objective of this senior project is to design a new portable swine processing machine dedicated to the Breschini & Sons farm, for the removal of the wild hogs.

LITERATURE REVIEW

An investigation was initiated to identify butchering processing, meat sanitation, and storage control.

Wild Hog Background

The wild boar is a species of the pig genus *Sus*, which is part of the biological family, Suidae. The species includes many subspecies. The term boar is used to denote an adult male of certain species. Wild boars are also known by various names, including wild hogs or simply boars. In North America they are commonly referred to as razorbacks or European boars. The physical characteristics of the wild boar include the body being compact, with a large head and relatively short legs, as seen in Figure 2. The color varies from dark grey to black or brown, but there are great regional differences in color, sometimes even whitish wild hogs may be found. (Wikipedia, 2009)

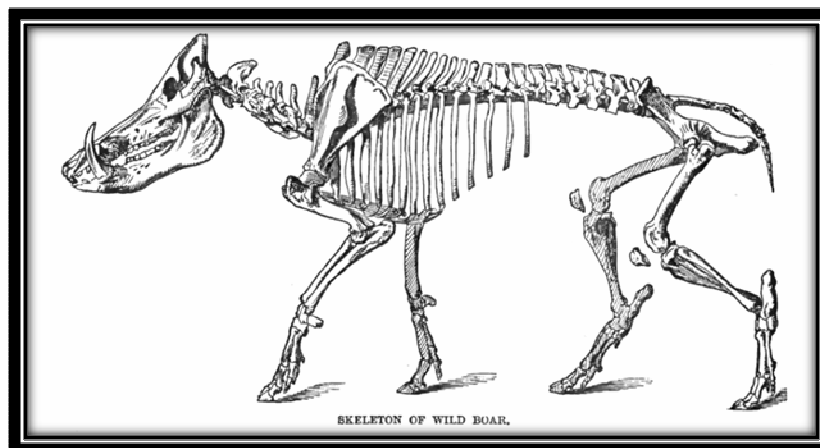


Figure 2. Skeleton of Wild Boar.

Wild Hog Reproduction

Sexual activity and testosterone production in males is triggered by decreasing day length, reaching a peak in mid-autumn. The normally solitary males then move into female groups, and rival males fight for dominance, whereupon the largest and most dominant males achieve the most matings. The age of puberty for sows ranges from 8 to 24 months of age depending on environmental and nutritional factors. Pregnancy lasts approximately 115 days and a sow will leave the group to construct a mound-like nest, 1–3 days before giving birth. The process of giving birth to a litter lasts between 2 and 3 hours, and the sow and piglets remain in, or close to,

the nest for 4–6 days. Sows rejoin the group after 4–5 days, and the piglets will cross suckle between other lactating sows. (Wikipedia, 2009)



Figure 3. Wild Boar Piglet

Litter size is typically 4-6 piglets but may be smaller for first litter, usually 2-3. The sex ratio at birth is 1:1. Piglets weigh 750g - 1000g at birth. Rooting behavior develops in piglets as early as the first few days of life, and piglets are fully weaned after 3–4 months. They will begin to eat solid foods such as worms and grubs after about 2 weeks. (Wikipedia, 2009)

Anatomy of Hog's Mouth

The anatomy of a hog's mouth, demonstrated in Figure 4, was researched in the design phase in order to find specific parts of the pig as to which the electric winching system can be attached too for proper skin removal from the carcass. A hard plate is located just above the nose of the hog, which will be the optimum location to attach the winch system. (Gregory, 2006)



Figure 4. Inside of Wild Hog Mouth.

Skin Threshing Machine

SIVVAS S. A. is a butchering processing company that constructs butchering equipment. SIVVAS has produced an electric pig dehider for the dehiding of pig carcasses. This unit contains two stainless steel rollers, one for fastening the carcass to the floor, and one for rolling the skin above the carcass. The skin is tied with one clamp to the roller with a system for automatic release of the skin after dehiding. The dehided carcass is left very clean and smooth with no fat left on the skin. (SIVVAS, 2007)

Stainless Steel

Stainless Steel is one of the most hygienic surfaces for the preparation of foods and very easy to clean, as its unique surface has no pores or cracks to harbor dirt, grime or bacteria.

It is very attractive and requires minimal care, since it won't chip or easily rust and it takes little seasoning. Stainless Steel will not affect flavor, as it does not react with acidic foods during food preparation or cooking. With proper care, it has a useful life expectancy of over 100 years, and it is totally recyclable. (Stainless Steel, 2008)

Health and Safety Codes (State of California Health and Safety Code, 2009)

The following health and safety codes address issues based upon the operation of the portable swine processing machine:

- 111950. "Food," as used in this chapter, includes all articles used for food, drink, confectionery, or condiment, whether simple or compound, and all substances and ingredients used in the preparation thereof.
- 111965. The floors, side walls, ceiling, furniture, receptacles, utensils, implements, and machinery of every food processing establishment shall at no time be kept in an unclean, unhealthful, or unsanitary condition.
- 111970. No live animal or fowl shall be kept or allowed in any establishment where food is prepared, manufactured, kept, stored, offered for sale or sold unless the establishment is exclusively devoted to the slaughter, processing and/or sale of the animal or fowl. This section does not apply to dogs used by uniformed employees of private patrol operators and operators of a private patrol service who are licensed pursuant to Chapter 11.5 (commencing with Section 7580) of Division 3 of the Business and Professions Code, while those employees are acting within the course and scope of their employment as private patrolmen.
- 112020. No employee or other person shall sit or lie upon any table, bench, trough, shelf, or other equipment that is intended for use in connection with any food manufacturing process. (State of California Health and Safety Code, 2009)

PROCEDURES AND METHODS

Design Procedure

The design constraints placed on this project came about through discussion with Dr. Cavaletto, Richard Breschini, research from swine butcheries, sanitation requirements, and laws and regulations in regards to swine processing.

To establish a accurate design procedure, a field trip was conducted at Bud's Custom Meats, which is located at 7750 Petaluma Hill Road, Penngrove, California 94951. Bud's Custom Meats is a family owned butcher shop, which opened in 1975. Bud's Custom Meats specializes in meat processing, smoking, ranch butchering, and sausage production for a variety of domestic and exotic animals. Bud's Custom Meats was chosen as the site for the research due to an on-site portable processing machine constructed by a butcher named Martin Peterson.



Figure 5. Bud's Custom Meats Sign

Bud's portable processing machine was constructed on a flat bed truck as seen in Figure 6. This concept provides the butcher with complete portability functions and the ability to drive to remote locations. The processing machine contained a refrigerator at the rear of the flatbed truck, able to hold about 15 wild hogs. The refrigerator, in Figure 7, was very spacious and provided an ideal temperature for storing wild hogs. As the opposite side of the trailer is approached, a crane, which is seen in Figure 8, has been assembled for the aiding of removing the skin from the wild hog. Here the wild hog is held stationary at the bottom of the trailer, and the skin is pulled away. Once this operation is completed, the wild hog is then slid into the refrigerator, until the butchering process begins.



Figure 6. Bud's Custom Meats Portable Processing Machine.



Figure 7. Inside Refrigeration Unit.



Figure 8. Crane located above refrigerator is used for skin removal.

Once the field trip was completed, many design factors were taken into consideration for the new design of the swine processing machine. As broken down in Figure 9, each station served as a necessary part in the processing of wild hogs.

Overview of Wild Hog Processing Machine

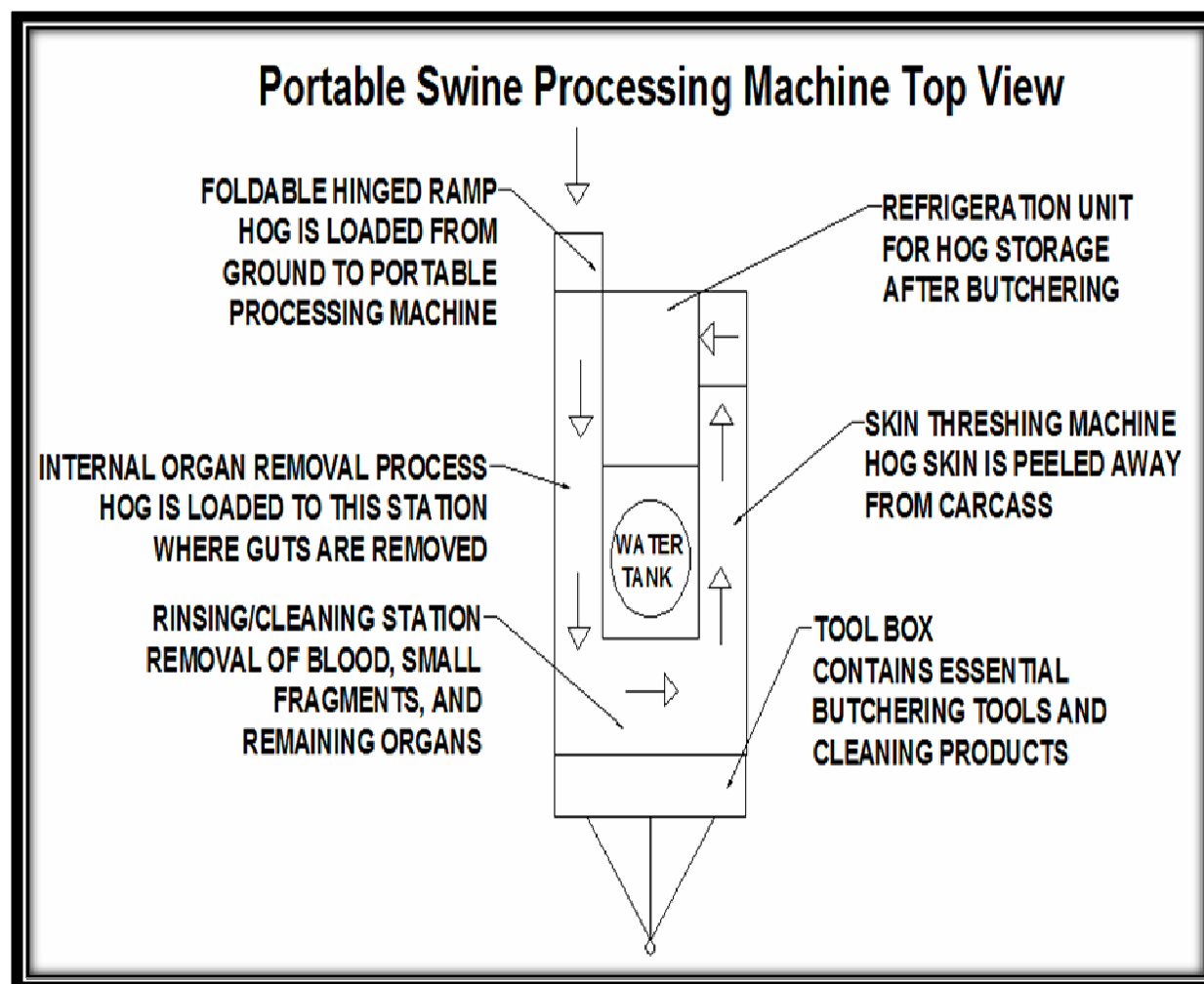


Figure 9. Overview of Wild Hog Processing Machine

Portable Component

The swine processing machine needed to be a portable device that could be able to handle moderate terrain. The device to be used was chosen to be a single axle trailer that is capable of holding the machinery and equipment necessary to complete the butchering process. The trailer to be used must be registered and ready for highway use. In addition, the trailer must have

specified places to hold the processed hogs and also have enough capacity to be able to hold the entire load of the butchering process.

Foldable Ramp

A foldable ramp is needed in this design process, in order to make it extremely easy for the user to carry the pig to the trailer. A simple stainless steel ramp will be designed with hinges, so the ramp can fold from the trailer down to the direct ground. This step allows the user to simply drag the pig up the slope of the ramp and continue to the first step of the pig processing machine.

Removal of Internal Organs and Parts

On one side of the trailer there will be a raised stainless steel rectangular table, which will be dedicated to the removal of the wild hogs internal organs and parts. The table must be stainless steel in order to provide an ease of cleaning and a barrier against rust and other contaminants that can be the harboring ground of germs and bacteria. The internal organs will be saved in five-gallon buckets with lids in order to contain the organs sanitarily. The internal organs will be marketed to and consumed by people whom consider the organs to be delicacies in their beliefs and customs.

Washing/Rinsing Station

After the hog passes through the removal of internal organs and parts component of the trailer, the hog will then be dragged on the same table where it will then form a 90 degree angle, on the corner of the trailer and continue to the front of the trailer. Here will be the washing and rinsing station, where a user can spray off the remaining blood and pieces of organs that may be left in exposure. This 90-gallon tank as seen in Figure 10, would be the ideal tank to get the job done. The rectangular shape creates no wasted space, and does not need a secured base like a round tank. Simply bolt in place with stainless steel straps. The tank has cutout grooves just for the stainless steel straps.



Figure 10. 90-Gallon Water Tank For Washing/Rinsing.

Skin Threshing Machine

Next, the portable pig processing machine will contain a 90 degree angle, where the pig can then be dragged from the washing/rinsing station directly to the skin threshing machine on the side of the trailer. This particular stage of the processing unit is the most critical part of the entire processing machine. A WARN winch system, shown in Figure 11, will be the main component used to remove the skin from the hog itself. Able to pull of load at 8000 pounds, this particular winch is an ideal choice for skin removal. A metal hook will be placed in the hog's mouth, above the larynx, and out the bottom part of the mouth. This meal hook will have the purpose of holding the hog stationary, while the winch system will pull the skin from the hog. The winch will contain a metal cable, which will have a gripping hook device designed to grip the skin just above the hog's maxillary nerve (top of mouth). Once the winch system is activated, the hog will be held in place, while the entire skin will be removed from the hog, as shown in Figure 12. The end result will be a dehided carcass, which is very sanitary and smooth.



Figure 11. WARN Winch for Pulling Force.

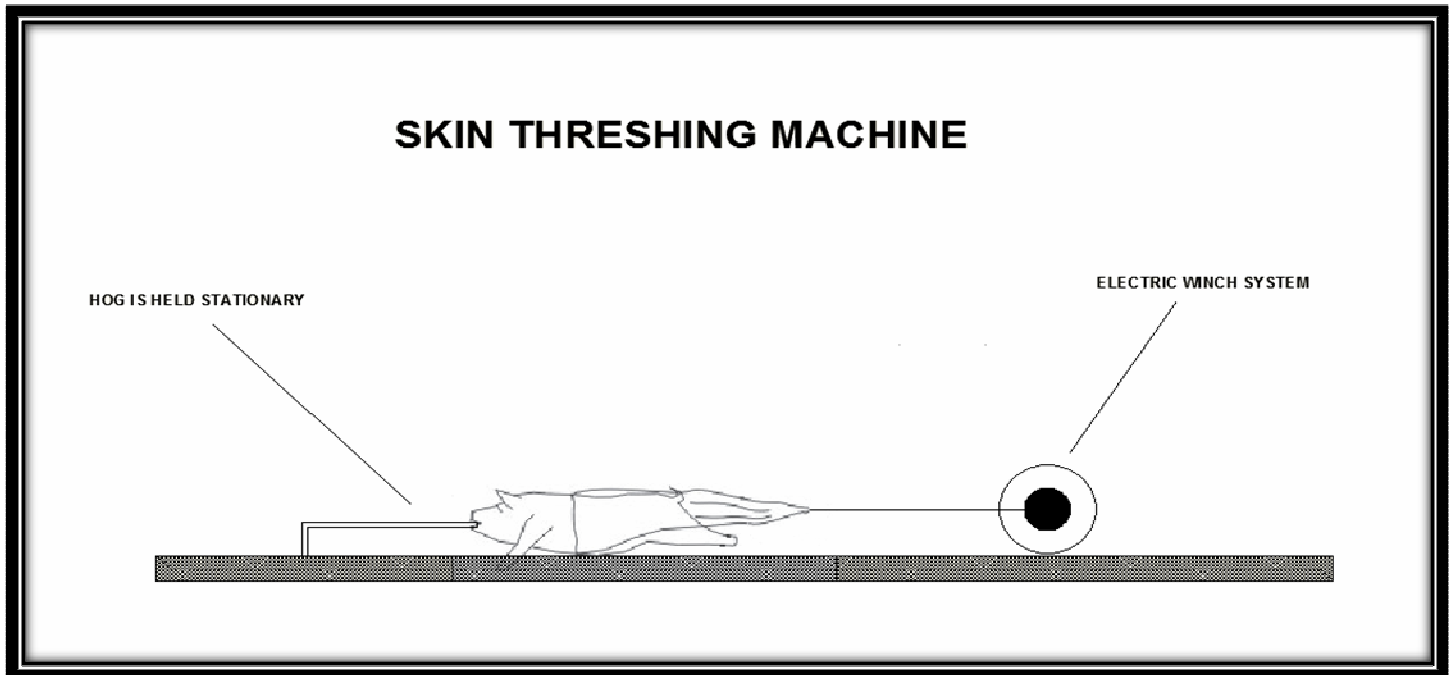


Figure 12. Skin Threshing Design.

Refrigeration Storage Station

After the pig passes through the skin threshing machine, the hog must be kept refrigerated. The hog can then be slid down the side of the trailer to a 90 degree turn, which will lead to the refrigeration storage station, located in the rear middle of the trailer. This can be viewed in Figure 13. Here the hog will be stored in a vast cooling enclosure, which will keep the hog refrigerated until consumption.



Figure 13. Portable Refrigeration Unit.

Tool Box

On the trailer, there is a need for the storage of butchering essentials, such as meat cleavers, saws, and other sanitation devices. The tool box was designed to be installed at the front of the trailer, near the ball hitch.

RESULTS

The final design of the swine processing machine provided the Breschini and Sons farm with a very efficient design to be constructed in the future. As seen in Figure 14, a design layout is provided to give a prime layout of the portable processing machine. This layout was created in order to construct a cost analysis for the Breschini and Sons farm.

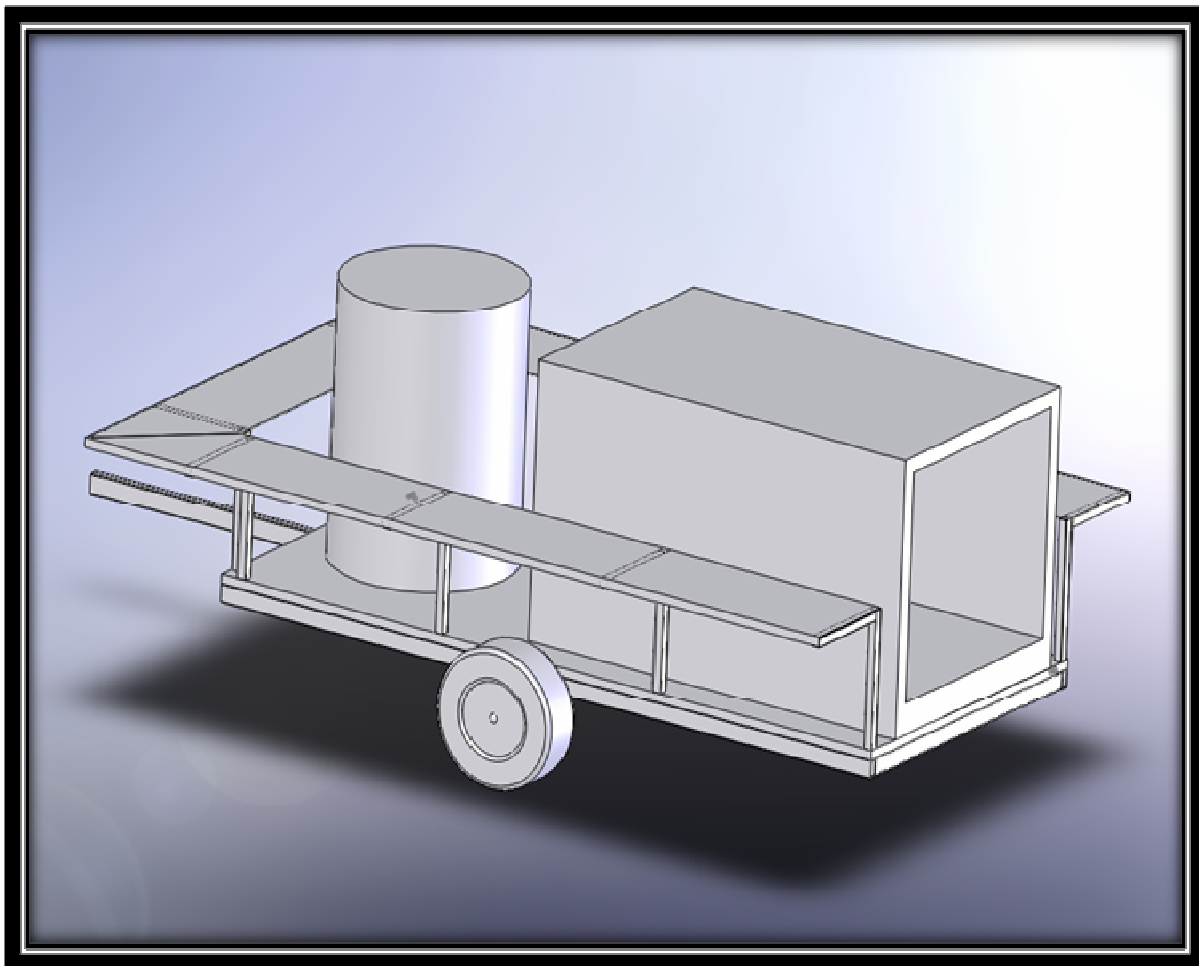


Figure 14. Design Layout of Portable Processing Machine

A cost analysis displayed in Table 1 breaks down the cost of each item, its purpose, and quantity. The owner of the Breschini and Sons farm, named Richard Breschini, issued a total budget of \$3000.00 for the financial statement. Overall, the design of the portable swine processing machine was able to stay within the designated budget, with a remainder of \$326.68.

Table 1. Cost Analysis of Portable Swine Processing Machine.

COST ANALYSIS			BUDGET=\$3000
ITEM	PURPOSE	QUANTITY	COST
Trailer	Transportation	1	\$0
Stainless Steel 16 GA. Sheet MIRROR Polish 4X10 Feet	Construction	2	\$1,451.20
Stainless Steel 11 GA. Sheet MIRROR Polish 4X10 Feet	Construction	1	\$317.52
Stainless Steel Angle 2X2X1/8 20 Feet	Construction	1	\$118.80
Stainless Steel Square Tube 2X2X16 Gauge 20 Feet	Construction	1	\$136.80
Water Tank (90 Gal.)	Rinsing/Cleaning	1	\$199
Refrigerator (Portable)	Cooling	1	\$0
Winch (WARN)	Skin Thresher	1	\$0
Additional Hardware	Construction	Not Applicable	\$200.00 Estimate
Tools	Butchering	Not Applicable	\$250.00 Estimate
		Total Cost=	\$2,673.32
		Total Budget=	\$3,000.00
		Surplus	\$326.68

NOTE: Items with amount \$0 are items provided by the Breschini and Sons Farm.

DISCUSSION

A major component to be discussed with this senior project was the use of the skin threshing machine. This particular component proved to be the most challenging aspect of the entire processing line. A great amount of research was performed on the skin thresher and different techniques were explored across the world.

The expected accuracy of the swine processing machine is up to four hogs per hour. This is a tremendous increase compared to performing the action by hand, which takes approximately one hour to complete from beginning to end.

During the design phase, many changes were accomplished. Given only a trailer floor to work with, a lot of time was generated to finding the appropriate places for each component of the processing system. Each part was taken into close consideration for the best possible efficiency to be achieved.

For safety analysis, health codes were taken very seriously and appropriate measures were placed into the design factor. Stainless Steel was designed to be the main building material, establishing sanitary conditions being able to meet or exceed health and safety codes regarding the processing meats. Also, safety precautions must be thought of when a user operates the portable processing machine. Many injuries and deaths can occur from butchering operations; therefore a user must be aware of the basics when it comes to the processing of meat.

RECOMMENDATIONS

For recommendations, there are certain factors that can be improved upon. The skin threshing machine proved to be an ideal solution to removing the skin from the hog, however, a problem arises with the thickness of the wild hog's skin. Since there is not a great amount of fat content in wild hogs, the skin threshing machine will tend to rip through the wild hog skin, causing the user to spend more time reattaching the hog skin to the machine. If an advancement is to be made, one must start here and establish a non-slip technique for the removal of the thin skin.

Another advancement to be made is the size of the refrigerator. Given a specified budget, cost was taken accountable for with the refrigeration unit. A larger refrigerator can be installed to provide storage for more wild hogs.

REFERENCES

Gregory, Michael Ph.D, . "Fetal Pig Dissection." *Welcome to the Biology Web*. N.p., 4/18/06. <http://faculty.clintoncc.suny.edu/faculty/michael.gregory/files/bio%20102/bio%20102%20laboratory/fetal%20pig/09.01.04.jpg>>.

Marr, Ron. "Hog Hunting Secrets." eHow. N.p., 22 July 2010. Web. 1 Dec 2010. <http://www.ehow.co.uk/list_6759078_hog-hunting-secrets.html>.

"Online Metals." Metals Depot. Ledford Steel Company, n.d. Web. 2 Dec 2010. <<http://www.metalsdepot.com/contact.phtml>>.

"Pacific West Refrigeration." Experts in Marine Refrigeration. N.p., n.d. Web. 2 Dec 2010. <<http://www.pacificwestrefrigeration.com/>>.

"SIVVAS S. A.." *Electric Pig Dehider*. N.p., 2007. Web. 26 May 2010. http://www.sivvas.com.gr/itemEN.asp?item_id=6&cat_id=1&cat_name=SLAUGHTERING%20EQUIPMENT%20produced%20by%20Sivvas%20SA.

"Stainless Steel." *Fante's Kitchen Wares Shop*. N.p., 2008. Web. 26 May 2010. <http://www.fantes.com/stainless-steel.html>.

"State of California Health and Safety Code." *Food Processing Establishments*. The California Food Sanitation Act, 2009. Web. 26 May 2010. <http://www.leginfo.ca.gov/calaw.html>.

"Water Tank." Top of the Line Detailing Supplies. N.p., 2008. Web. 2 Dec 2010. <<http://www.topoftheline.com/90galwattan.html>>

"Warn M8000." WARN Truck & Auto. N.p., n.d. Web. 1 Dec 2010. <<http://www.warn.com/truck/winchessrc/M8000.shtml>>.

"Wild Boar." Wikipedia. N.p., n.d. Web. 1 Dec 2010. <http://en.wikipedia.org/wiki/Wild_boar>.

APPENDIX A

HOW PROJECT MEETS REQUIREMENTS FOR THE ASM MAJOR

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ASM Project Requirements

The ASM senior Project must include a problem solving experience that incorporates the application of tech the application of technology and the organizational skills of business and management, and quantitative, analytical problem solving. This Project addresses these issues as follows.

Application of Agricultural Technology. This project will involve the application of mechanical systems and fabrication technologies for the production of the swine processing machine.

Application of Business and/or Management Skills. This project will involve management skills in the areas of cost and productivity analyses, machinery management, and labor considerations.

Quantitative, Analytical Problem Solving. Quantitative problem solving will include the cost analysis along with the design of the swine skin thresher. The analytical problem solved will be the lowering of the wild pig population on the Breschini & Sons Farm.

Capstone Project Experience

The ASM Senior Project must incorporate knowledge and skills acquired in earlier course work (Major, Support/GE courses). This project incorporates knowledge/skills from these key courses.

- BRAE 129 Laboratory Skills and Safety
- BRAE 141 Agricultural Machinery Safety
- BRAE 142 Agric Power/Machinery Mgt.
- BRAE 151 CAD for Agricultural Engineering
- BRAE 203 Agricultural Systems Analysis
- BRAE 301 Hydraulic/Mechanical Power Systems
- BRAE 321 Agricultural Safety
- BRAE 324 Principles Agricultural Electrification
- BRAE 342 Agricultural Materials
- BRAE 343 Mechanical Systems Analysis
- BRAE 348 Energy for a Sustainable Society
- BRAE 418 Agricultural Systems Management I
- BRAE 419 Agricultural Systems Management II
- BRAE 425 Computer Control for Agriculture
- BRAE 460 Senior Project Organization
- BRAE 461 Senior Project I
- PHYS 121 College Physics I
- CSC 110

ASM Approach

Agricultural Systems Management involves the department of solutions to technological, business or management problems associated with agricultural or related industries. A system approach, interdisciplinary experience, and agriculture training in specialized areas are common features of this type of problem solving. This Project addresses these issues as follows.

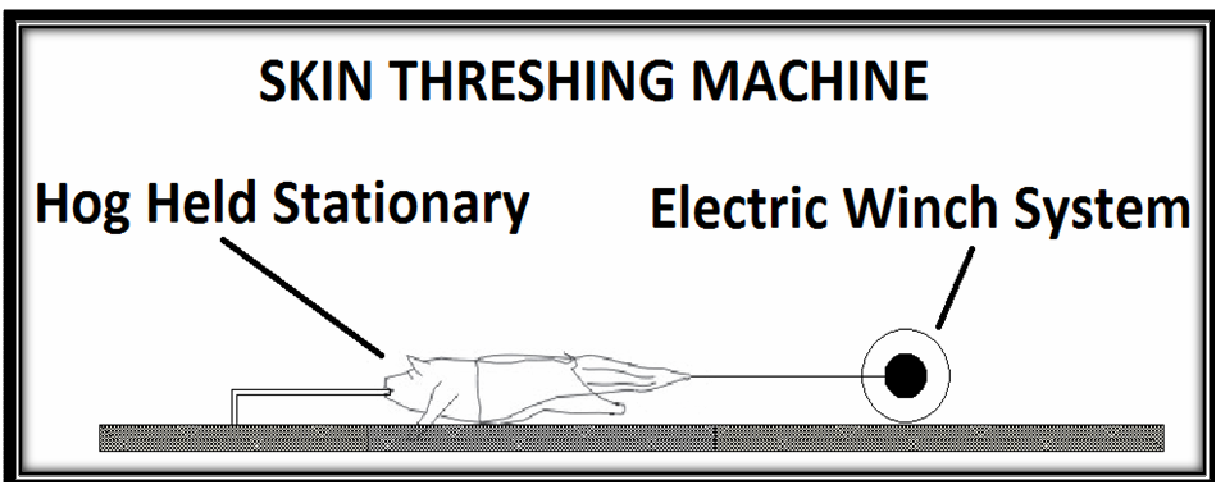
Systems Approach. This project qualifies for the system approach by involving the integration of multiple functions and machinery operated system for the processing of wild hogs.

Interdisciplinary Features. This project contains aspects of mechanical systems, agricultural safety and the harvesting of wild hogs.

Specialized Agricultural Knowledge. This project applies specialized knowledge in the areas of mechanical and fabrication systems, and agricultural safety.

APPENDIX B

CONSTRUCTION DRAWINGS



Portable Swine Processing Machine Top View

